



MONITORING AND EVALUATION

The current understanding of the Quivira NWR ecosystem has been greatly enhanced by past monitoring and evaluation studies of vegetation and animal communities, water quality and quantity, and specific management actions. When detailed topographic maps are available, additional analyses of vegetation distribution and relationships with hydrogeomorphic attributes of the system should be possible. Future management of the system should continue key monitoring studies and also conduct select directed studies as needed. Monitoring is determined primarily by refuge objectives, but some measures should be collected that indicate how factors related to ecosystem structure and function are changing, regardless of whether the restoration and management options identified in this report are undertaken. Ultimately, the success in restoring and sustaining communities and ecosystem functions and values at Quivira NWR will depend on how well the physical integrity and hydrological processes and events, especially the sustained groundwater discharges into and within the refuge can be restored, maintained, and emulated by management actions. Uncertainty exists about the future of some important water issues and the ability of the USFWS to make some system changes because they are not completely under the control of the USFWS. Also, specific techniques for certain management actions, such as controlling and reducing introduced plant species, are not entirely known.

Whatever future management actions occur on Quivira NWR, activities should be done in an adaptive management framework where: 1) predictions about community response and water issues are made (e.g., increased diversity and vigor of native grass and meadow species) relative to specific management actions (e.g., restoration of sheetwater flow and regular fire recurrence) in specific locations or

communities (e.g., loess sand hill grassland) and then 2) follow-up monitoring is conducted to evaluate ecosystem responses to the action. Information and monitoring needs for Quivira NWR related to the hydrogeomorphic information evaluated in this report are identified below:

GROUND AND SURFACE WATER QUALITY AND QUANTITY

The recently completed WRIA for Quivira NWR identified several important future monitoring and information needs related to water. These and other needs include:

- Revised and updated information on all water-control and conveyance structures and determining annual water budgets for all wetland management units and the refuge as a whole.
- Annual monitoring of water management and storage/flooding especially as related to future changes in water use and management identified in this report.
- Completion of bathymetry and detailed topographic information for all wetland units and the Big and Little Salt Marsh areas.
- Routine monitoring of water quality and contaminant issues in relation to water source and routing. Regular monitoring of surface, ground, and soil salinity if key reference locations related to HGM-determined communities should be established.
- Water flow metering at key points in the refuge.

- Documentation of how existing water rights are being met, used, and maintained.

RESTORING NATURAL TOPOGRAPHY, WATER FLOW PATTERNS, AND WATER REGIMES

This report identifies several physical and management changes that could help restore some more natural topography, water flow, and flooding/drying dynamics in managed wetlands. These changes include restoring at least some more natural water flow through natural drainages and across sandhill and higher alluvial terraces in a sheetflow manner and managing impoundments (that are retained) for more natural spring-flooded seasonal flooding regimes. Further, restoring interannual dynamics of flooding and at least partial drying of the Little Salt Marsh and managed impoundments is desired. The following monitoring will be important to understanding effects of these changes if implemented:

- Annual monitoring of water use and distribution including water source, delivery route and mechanism, extent and duration of flooding and drying, and relationships with non-refuge water and land uses in the GMD No. 5.
- Documentation of how water moves across sand hill and alluvial areas.
- Evaluation of surface and ground water interactions and flow.

LONG TERM CHANGES IN VEGETATION AND ANIMAL COMMUNITIES

The availability of historic vegetation information coupled with regularly documenting changes in general and specific vegetation communities is extremely important to understand the long term changes and management effects on Quivira NWR. Also, regular monitoring of at least some select animal species or groups helps define the capability of the Quivira NWR ecosystem to supply key resources to, and meet annual cycle requirement of, animals that use the refuge and regional area. Important survey/monitoring needs include:

- Detailed inventory and mapping of plant species composition, distribution, produc-

tivity, and coverage in all habitats, especially grasslands.

- Coverage, including expansion and contraction rates of invasive and woody species.
- Abundance, chronology of use, survival, and reproduction of key waterbird and neotropical migrant songbirds including dabbling ducks, geese, sandhill cranes, least tern, piping and snowy plover, other shorebirds, and grassland nesting passerines.
- Rates and occurrence of fire, grazing, and mechanical disturbances in wetlands and grasslands.
- Occurrence, distribution, and abundance of amphibians and reptiles.



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